MEASUREMENT OF LIGHT SCATTERED FROM A LASER BEAM BY THE ATMOSPHERE

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I. INTRODUCTION

This report summarizes the research activities supported by NASA Grant NsG-710 during the period of June 1, 1966, to November 30, 1966.

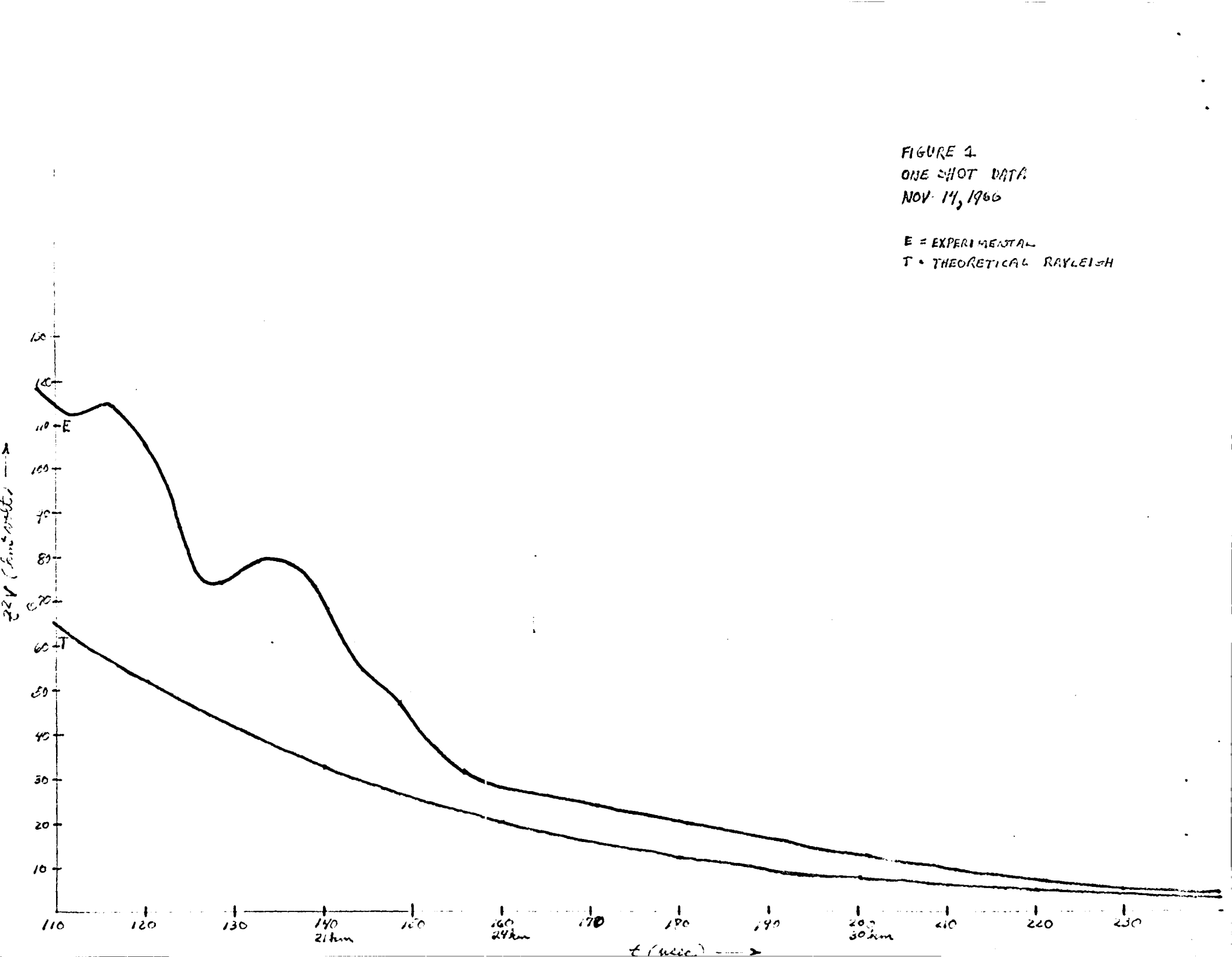
Laser backscatter measurements of the atmosphere at the ruby laser wavelength - 6943A°- have been continued. Damage to our harmonic generator has necessitated delay of measurements at other wavelengths. Data reduction and analysis has continued, and most of the associated computer and plotting programs have been completed. A typical example of the data obtained is given in Figure 1 where T represents the theoretical Rayleigh return and E, the experimental.

On October 31, 1966, a series of experiments was conducted in conjunction with the Langley Research Center of NASA. A Langley Research Center jet trainer equipped with optical radar was flown horizontally at various altitudes and simultaneous vertical soundings were made with our equipment. The data obtained showed essentially the same gross characteristics (i.e., an aerosol layer at 3 km. was evident in both sets of observations). Quantitative analysis of both sets of data is in progress.

Theoretical analysis of the problem has proceded. The calculation of Mie scattering coefficients up to size parameters of 100 in steps of 0.1 for an index of refraction of 1.5 has been completed. Larger values of size parameters have been examined for convergence. The effect of absorption has been investigated also. These data have been used to obtain Mie scattering cross sections for the atmosphere assuming various size distribution parameters. This work will be continued

FIGURE 1
ONE SHOT DATA
NOV 14, 1966

E = EXPERIMENTAL
T = THEORETICAL RAYLEIGH



during the next six months with a much faster computer becoming available in February, 1967.

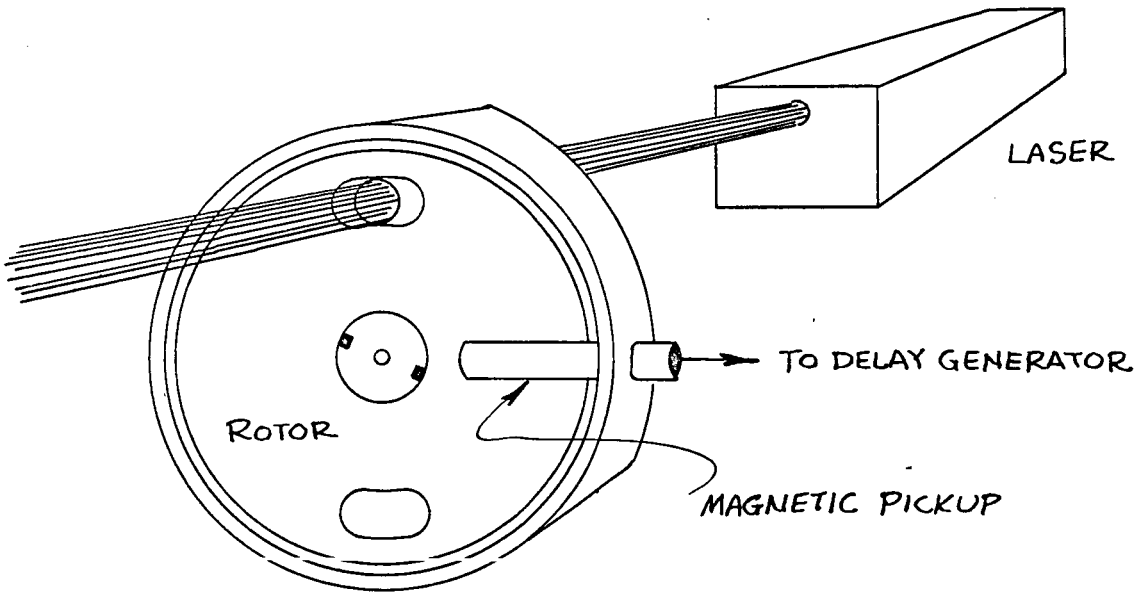
II. RESEARCH ACTIVITIES

Several major improvements have been made in the experimental apparatus during the last six months.

An improved temperature controlling system has been developed and incorporated into the Lear Siegler Company laser. The temperature of the ruby rod is controlled so that the output wavelength does not coincide with atmospheric water vapor absorption bands.

A high speed rotating shutter has been constructed and is now in use. The shutter eliminates near scatter of flashlamp and flouresence radiation and greatly facilitates the measurement of low level signals. Figure 2 depicts the main functions of the shutter assembly. Synchronization of the shutter with the laser pulse is achieved by remote triggering the laser flashlamps with a pulse derived from the rotating disc. The rotor closes off the laser cavity 130 μ sec. after the q-switched pulse passes through the slot.

A fast multiscaling system has been delivered and will soon be incorporated into the system. The instrument is a 10MC random pulse counter/memory system and will be used for "photon counting." The salient features of the system include a variable, preselectable



ROTATING SHUTTER

Figure 2

time base and a dead time between channels of less than 100 nanoseconds. The instrument contains sufficient memory to permit a total counting time of 1500 μ sec. which may be divided into channels of width variable from 4 μ sec. to 128 μ sec. This system will be used in conjunction with a 12-inch Cassegrainian telescope and cooled photomultiplier detector to extend the range of our measurements.

III. PERSONNEL

The personnel working on this problem are listed below.

Faculty

Dr. James D. Lawrence, Jr.

Associate Professor of Physics

Principal Investigator

Dr. Frederic R. Crownfield

Associate Professor of Physics

Graduate Students (Supported by scholarship where indicated)

Mr. M. P. McCormick; B.S., M.A. (Research Assistantship)

Mr. D. P. Woodman; B.S., M.S. (Research Assistantship)

Mr. Larry Owen, B.S. (Research Assistantship)

Technician

Mr. C. B. Hinton, Jr.